Malnutrition and Role of Nutrition in BMD:CKD

PNDS Continuing Nutrition Education Seminar
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Outline

- Objective
- Malnutrition in CKD population
- Bone Mineral Disorder in CKD
- Goals of Nutrition Therapy
- CKD-BMD Nutritional Management guidelines (Cal, phos, Vit D, PTH)
- Dietary Management of PEM and BMD-CKD
Objective

- To recognize the importance of early nutrition intervention in the management of Malnutrition and Bone Mineral Disorder.
Malnutrition

Inflammation + Uremic Toxins

Poor Dietary Intake & Increased Metabolic Stress

Decreased Protein Synthesis

DECLINE IN NUTRITIONAL STATUS
Malnutrition in CKD

National Institute of Clinical Excellence defines malnutrition as

- **BMI scores of 18.5 or less.** Muscle wasting and/or loss of subcutaneous fat on exam
- **Unintentional weight loss of 10% or more** in previous 3-6 months.
- **BMI < 20** and **unintentional weight loss >5%** in 3-6 months

(National Collaborating Centre for Acute Care 2006)
Prevalence of Malnutrition

- 42-77% Malnutrition (mean s.alb 2.39 g/dl) is prevalent in ESRD population of developing countries

- With Malnutrition mortality increases by 18–70%

Advances in Renal Replacement therapy, Vol. 10, No.3 (July), 2003: pp213-221
Goals of Nutrition Therapy

- Maintain optimal Nutritional Status:
  - Prevent or correct nutritional deficits

- To slow progression:
  - Control hypertension by reducing sodium intake
  - Reduce protein intake IF EXCESSIVE
  - Manage DM

- Treat Complications:
  - Malnutrition, Metabolic Acidosis, Hypercalcemia, Mineral Imbalance and Bone Disorder, Anemia, CVD & dyslipidemias

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Screening for malnutrition

CKD Stage 1-4

- Actual Body Weight (< 85% of IBW)
- Reduction in body weight (of 5% or more in 3 months or 10% or more in 6 months)
- BMI (kg/m²) < 20
- Subjective Global Assessment (SGA)

Dialysis

- Serum Albumin & Dry Wt (Monthly)
- SGA (3-6 months)
- In case of consistent decrease of 0.3g/dl S.alb over 2-3 months then
- Dietary interviews, anthropometry, Dual energy X-ray absorptiometry and C-reactive Protein

The Renal Association, Clinical Practice Guidelines Reviewed in 2013

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Nutritional Status Evaluation and Management

**Moderate Undernutrition**
- Spontaneous intakes ≤ 30 kcal/kg/day
- Spontaneous intakes ≤ 1.1 g protein /kg/day

**Severe Undernutrition**
- BMI < 20
- Body wt loss > 10% within 6 mo
- Albumin < 35 g/l

**Spontaneous intakes**
- > 20kcal/kg/d
- < 20kcal/kg/d or Stress conditions

**Dietary counseling**

**Oral supplements**

**Lack of compliance**

**IDPN**

**Enteral Nutrition if EN is not possible:**
- Central venous PN

**ESPEN Guidelines**
Chronic Kidney Disease Mineral and Bone disorder (CKD-BMD)

Abnormal levels and bioactivity of: Calcium, Phosphorus, PTH, 25(OH)D, 1,25(OH)2 D

Bone Abnormalities
- Fractures, pain, decrease in mobility, strength or growth

Vascular and Valvular Disease (Calcification)

Cardiovascular Disease Events

Disability, Low Quality of Life, Hospitalizations & Death
Phos and Calcium metabolism in CKD

- As GFR falls due to **fall in the activity of Vit D** (conversion impaired, Vit D dependent Calcium absorption from intestine is impaired) Blood concentration of calcium falls.

- **Phos excretion decreased** due to decrease tubular function stimulate fibroblast growth factor and Vit D become limited (D2 conversion is limited, skin conversion is limited, protein malnutrition promote Vit D deficiency.)
Continued..

- **Reduced Vit D activity** stimulate **increased PTH** secretions to release calcium from bones, Phos also releases and cause hyperphosphatemia. Hyperphosphatemia also cause to increase PTH. Active Vit D is given to suppress PTH production.

- As a result of these metabolic changes progressive and persistent increase in PTH occur.

- Extreme high levels of PTH has been associated with worsened survival of patients with ESRD.
Renal Bone Disease
Osteodystrophy

Depending upon the type of renal bone disease, Cal, Phos, PTH may be normal, decreased or elevated.

- **Osteitis Fibrosa Cystica**
  - High Bone turnover Disease
  - Hyperparathyroidism (HPTH)

- **Adynamic Bone Disease**
  - Low Bone Turn Over
due to over suppression of PTH

- **Mixed Bone Disease**
  - Have features of both

- **Osteomalacia OR Bone Demineralization**
CKD-BMD Management

Given the risk of BMD associated with hyperparathyroidism, attempts to normalize levels of Ca, P, and regulate the levels of PTH have been central to the management of CKD.

<table>
<thead>
<tr>
<th></th>
<th>CKD Stage 3</th>
<th>CKD Stage 4</th>
<th>CKD Stage 5 (on dialysis)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>P (mg/dL)</strong></td>
<td>2.7 - 4.6</td>
<td>2.7 - 4.6</td>
<td>3.5 - 5.5*</td>
</tr>
<tr>
<td><strong>Ca (mg/dL)</strong></td>
<td>“Normal”</td>
<td>“Normal”</td>
<td>8.4 - 9.5; Hypercalcemia = &gt;10.2</td>
</tr>
<tr>
<td><strong>Intact PTH (pg/mL)</strong></td>
<td>35 - 70</td>
<td>70 - 110</td>
<td>150 - 300*</td>
</tr>
</tbody>
</table>
Intervention for bone disease in CKD

- Phosphorus restriction
- Adequate, not excessive protein
- Phosphorus binding medications
- Usually calcium based salts
- Vitamin D and analogs

Early intervention may help prevent vascular calcification and secondary hyperparathyroidism
Calcium

- Control of calcium levels helps control PTH

- Average dietary intake 500-800 mg/day

- Total elemental Calcium provided by Calcium based phosphate binders is **1500mg/day**.

- Total intake of elemental calcium including dietary calcium should keep between **1500-2000mg/day**.

continued..
• Hypercalcemia is one of frequent complications by the use of Ca containing binder and use of active Vit D sterol.

• Calcium acetate - Calcium carbonate
• Calcium citrate - increase aluminum absorption

• Hypercalcemia occurs specially in those with low bone turnover disease.

• Hypocalcaemia cause development of hyperparathyroidism and increase risk of mortality. Active Vit D and analogs are effective in lowering PTH and increase calcium

• Calcimemertics or calcium imitating drugs are useful in suppressing PTH but close monitoring is essential (Slatopolsky et al, 2000)
Phosphorus

- Serum phosphorus levels may be “normal” until CKD is advanced.

- Dietary Phosphorous levels should be restricted to 800-1000mg/day when serum levels go beyond 4.6mg/dl.

- Phosphorus restriction in early RF may help in the prevention of high PTH levels and development of renal bone disease.

- Dose and timings of phosphate binders should be individually adjusted to the phosphate content of meals and snacks to achieve desired levels.

- GI upset is one of the side effect with most binders therefore interfere compliance (Toma sello et al,2004).

Continued.....
During counseling patients, the absolute amount of dietary P, its type, source, and ratio to dietary protein should also be considered.

A mixed combination of dietary animal and plant food rich in phytic acid should be encouraged.

Dietary phosphate control should not compromise protein intake. Dietary education improves phosphate control.

Dietary protein restriction decreases phosphorus intake. If further restriction is needed, counsel patients to reduce intake of foods with added phosphorus (Uribarri, 2007).
Calcium Phosphorus Product

If calcium phos product is greater than 70, metastatic calcification is imminent. Clinical management aims to keep it below 55

\[(S. \text{ Cal mg/100 ml}) \times (S. \text{ Phos mg/100 ml}) \]
\[(9.0 \text{ mg/100ml}) \times (6.5 \text{ mg/100ml}) = 58.5\]

Observational studies in dialysis patients have linked hyperphosphatemia, cal phos. product and HPTH with higher cardiovascular mortality.
Phosphorus absorption varies by source

**Organic Phos**  40-60% Absorbed
- Dairy products
- Meat, fish, poultry
- Seeds and nuts
- Soy
- Dried beans and peas
- Whole grains
(Pytate based P less bioavailable)

**Inorganic Phos**  >90% readily absorbed
- Food additives
- Dietary supplements
- Calcium fortification

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**Inorganic P**

- P is the main component of many preservatives and additive salts in processed foods
- Not protein bound
- More easily disassociate and absorbed in intestinal track
- P burden from P containing food additives is disproportionately higher relative to organic P found in animal and plant foods sources of protein

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**Soft Drinks, convenience foods, fast food, colas, soft drinks**

Clear colored soft drinks and teas are low in P

Quantity of P in a 50 gm portion of Cheese varies from <100 mg in Brie cheese to almost 500 mg in processed soft cheese.
Dietary P and Protein intake in CKD

- Protein intake ---- P intake ---- Hyperphosphatemia

- A recent 3 yr epidemiological study of 30,075 prevalent MHD patient showed a decline in Pre dialysis serum P & Dietary P restriction ----

- Protein intake----Protein Wasting and Poor Survival / Increased risk of death

- Protein intake and a concurrent phos intake with serum P declined over time seems to be associated with lowest mortality in patients with CKD

## P to Protein Ratio

<table>
<thead>
<tr>
<th>Food group</th>
<th>Phos (mg)</th>
<th>Protein (gms)</th>
<th>P to Protein Ratio (mg/gm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole grain</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Refined</td>
<td>85</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beans and Peas ½ C</td>
<td>119</td>
<td>7.6</td>
<td>15.8</td>
</tr>
<tr>
<td>Egg White</td>
<td>5</td>
<td>3.6</td>
<td>1.4</td>
</tr>
<tr>
<td>Egg Yolk</td>
<td>65</td>
<td>2.6</td>
<td>22.8</td>
</tr>
<tr>
<td>Lentils ½ C</td>
<td>178</td>
<td>8.9</td>
<td>20.0</td>
</tr>
<tr>
<td>Milk low fat 1 Cup</td>
<td>230</td>
<td>8.1</td>
<td>28.3</td>
</tr>
<tr>
<td>Red Meat (Ground Beef) 3 oz</td>
<td>165</td>
<td>21.9</td>
<td>7.5</td>
</tr>
<tr>
<td>Cheese Cheddar 1 oz</td>
<td>145</td>
<td>7.1</td>
<td>20.4</td>
</tr>
<tr>
<td>Chicken Drumstick</td>
<td>81</td>
<td>12.5</td>
<td>6.5</td>
</tr>
<tr>
<td>Chicken Liver 1</td>
<td>79</td>
<td>4.8</td>
<td>16.5</td>
</tr>
<tr>
<td>Sunflower Seeds 3 Tb Sp</td>
<td>370</td>
<td>6.2</td>
<td>59.7</td>
</tr>
</tbody>
</table>

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**PTH (Parathyroid hormone)**

**PTH** regulates serum calcium levels. Low levels of 1,25(OH)2D, hypocalcemia, and hyperphosphatemia stimulate PTH secretion.

Secondary Hyperparathyroidism is associated with the most common cause of bone disease in CKD

- Normal PTH < 65 pg/mL
  - Measured as iPTH
  - PTH varies by level of kidney function and type of bone disease

Dietary phosphorus restriction and use of active vitamin D or its analogs may help control PTH levels in CKD. Calcium supplementation may help as well.
Vitamin D

- The kidneys activate 25(OH)D (Calcidiol) to 1,25(OH)2D (Calcitriol or active vitamin D).

- Reduction of kidney function results in decreased production and conversion of calcidiol to calcitriol.

- Vitamin D ≥ 20 ng/mL Measured as 25(OH)D Maintain within normal range (IOM, 2011).
Supplementation may be indicated. Specific requirements in CKD have yet to be determined.

- Ergocalciferol (vitamin D2) or cholecalciferol (vitamin D3) may be used in early CKD to replete vitamin D.

- Active vitamin D(calcitriol) or its analogs (doxercalciferol, paricalcitol, or alfacalcidol) may be used as eGFR declines (ibid).

- Monitor for hypercalcemia and hyperphosphatemia when using supplements.
- Active vitamin D increases calcium and phosphorus absorption.
Energy & Protein

30-35 Kcal/kg/BW and 0.75-1.2 gm/kg/BW is recommended to maintain positive nitrogen balance, good nutritional status and healthy weight.

25-30% Fats

55-60% Carbohydrates

15% Proteins (50% HBV)
1 Slice BREAD OR ½ C Cooked CEREALS OR RICE OR ½ Med CHAPATI = 60-80 kcals

1 Tbsp Fat = 100-120 Kcals
Sources of Protein

2 Oz of Cooked Lean MEAT, CHICKEN, FISH, ½ CUP LENTILS or 1 EGG = 7-8 gms Protein
1 Cup YOGURT OR MILK = 300-350 mg Calcium

1 Slice Cheese = mg Calcium
# Sample meals with nutrient content

<table>
<thead>
<tr>
<th>Nutrients</th>
<th>Breakfast</th>
<th>Lunch</th>
<th>Dinner</th>
<th>Snack 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy (Kcal)</td>
<td>430</td>
<td>612</td>
<td>430</td>
<td>330</td>
</tr>
<tr>
<td>Protein (gms)</td>
<td>12</td>
<td>34</td>
<td>38</td>
<td>3</td>
</tr>
<tr>
<td>Calcium (mg)</td>
<td>87</td>
<td>154</td>
<td>313</td>
<td>8</td>
</tr>
<tr>
<td>Phos (mg)</td>
<td>150</td>
<td>320</td>
<td>320</td>
<td>10</td>
</tr>
</tbody>
</table>

| Kcal          | 475+200   |       |        |         |
| Protein       | 22+8      |       |        |         |
| Cal           | 170+200   |       |        |         |
| Phos          | 166+200   |       |        |         |

| Kcal          | 330       |       |        |         |
| Protein       | 3         |       |        |         |
| Cal           | 8         |       |        |         |
| Phos          | 10        |       |        |         |
# Food Exchanges with Nutrients

<table>
<thead>
<tr>
<th>Food groups</th>
<th>Energy (kcals)</th>
<th>Protein (Gms)</th>
<th>Calcium (mg)</th>
<th>Phos (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chicken or fish or lentils 100gms cooked</td>
<td>220</td>
<td>32</td>
<td>25.5</td>
<td>306</td>
</tr>
<tr>
<td>Vegetables 2 Servings</td>
<td>50</td>
<td>4</td>
<td>36</td>
<td>74</td>
</tr>
<tr>
<td>Fruit 2 Servings</td>
<td>120</td>
<td>2</td>
<td>9</td>
<td>8.7</td>
</tr>
<tr>
<td>Chapatti / cereals / bread 8-10 Servings</td>
<td>640</td>
<td>18</td>
<td>216</td>
<td>188</td>
</tr>
<tr>
<td>Oil 6 Tb Sp</td>
<td>600</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Milk or its product 1 cup</td>
<td>150</td>
<td>8</td>
<td>291</td>
<td>227</td>
</tr>
<tr>
<td><strong>Approx. Total</strong></td>
<td><strong>1780</strong></td>
<td><strong>64</strong></td>
<td><strong>577</strong></td>
<td><strong>803</strong></td>
</tr>
</tbody>
</table>

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ADA-CKD Evidence based clinical practice guidelines

- Nutrition therapy provided by a RD is recommended for individuals with CKD.

- Should be initiated at the diagnosis of CKD

- Studies regarding effectiveness of diet therapy report significant improvements in anthropometric and biochemical measures sustained for at-least one year.
Conclusion

Malnutrition  Morbidity  Mortality

Focus on

- Identification of risk factors
- Anticipatory guidance
- Assure compliance

Nutritional assessment

- Economical
- Easy to use
- Combination of anthropometric biochemical & dietary periodic assessment

Monitoring & Follow up

Co-ordination between Physician & Dietitian
THANK YOU